brownish, underlined with reddish brown; a reddish spot on inner margin near base; faint traces of a rusty brown inner line and wavy exterior line at five sixths; a small brown subcostal spot in middle of cell; two snow-white spots on the angles of the cell, the upper the larger, edged with brown, and lying in a small brown blotch; fringe and nervures towards hind margin faintly tinged with brown. Hind wings with discal spot and sinuous indistinct central line ferruginous; fringe and hind margin much tinged with brown; face yellow, with a narrow reddish bar at base; shoulders with a reddish line at sides; collar, patagia, thorax, and abdomen all gilded yellow; thorax with a red-brown central spot and the crest red-tinted; second segment of abdomen with two largish reddish spots; anal tuft reddish brown; palpi dark brown, the basal joint white. Underside paler yellow, with very faint markings.

Expanse of wings 24 millim.

One male, Queensland.

[To be continued.]

MISCELLANEOUS.

Contributions to the Embryogeny of Simple Ascidians.

By Antoine Pizon.

Several points in the development of the Simple Ascidians are still disputed or unknown, especially the origin of the peribranchial cavity, the relations of the sensory vesicle to the neighbouring parts, and the existence of an *epicardium* analogous to that which is found in the Compound Ascidians. The species which I have had at my disposal for the purpose of studying these different points are *Cynthia morus* and *Ascidia villosa*, Giard.

The earliest phenomena of segmentation are dissimilar in these two species, and this is due to the fact that *Cynthia morus* possesses an enormous quantity of food-yolk, of which we still find a considerable portion in the larva at the moment of hatching.

I.—After the formation of the cavity of the archenteron in *Ascidia villosa*, its walls send out two lateral extroflexions which grow pretty rapidly, while each of them speedily attaches itself to the ectoderm. The latter layer on its part becomes slightly invaginated at the two points of contact and then perforated; the larva henceforth exhibits two new apertures, which are added to that of the stomodæum, and the existence of which was first demonstrated by Krohn and Kovalewsky. The enteric cavity is gradually enveloped by the dilatation of its two diverticula, which become the peribranchial cavity. The two lateral apertures are thrust more and more into the median line on the dorsal side in consequence of the development of the larva; finally they unite and form but a single orifice, which will be the cloacal aperture of the adult.

II.—The heart in *Ascidia villosa* and *Cynthia morus* is formed, as in the Compound Ascidians, by a diverticulum of the enteric cavity, which becomes isolated at an early period when the peribranchial sacs are in process of development. This diverticulum becomes a little closed sac, a certain portion of the wall of which is forthwith invaginated, thus producing a double cavity: the inner one is the *cardiac cavity*, which communicates by the cleft of invagination with the hæmal spaces; the outer chamber is the *pericardium*, which is completely closed and does not contain a drop of blood; it represents a portion of the archenteron.

III.—All along the cardiac cleft, and applied to it in the manner of an obturator, is seen another sac with very delicate epithelial walls. At the time of the appearance of the first branchial clefts in *Ascidia villosa*, this sac still has a wide opening into the enteric cavity from which it is derived, while its other extremity gradually elongates and moulds itself round the alimentary tract after the fashion of a mesentery.

In its origin, disposition, and relations to the heart this sac is absolutely identical with the *epicardium*, which hitherto was known only in the Compound Ascidians.

In *Cynthia morus* the epicardium appears as two great prolongations of the peribranchial sacs, and thus recalls with great exactness the arrangement which I have described in the Botryllidæ.

The mode of formation of this aperture is precisely as described long ago by Krohn and Kovalewsky and since observed by all ascidiologists; but the point on which I desire to insist is *the endodermal origin of the peribranchial cavity*. I therefore do not share the view of Metschnikoff and Kovalewsky, who have maintained that this cavity is due to *two ectodermal invaginations*, which gradually surround the cavity of the enteron. These two learned naturalists, whose endeavours to study the transparent embryo were evidently impeded by the egg-membranes, were unable to make out precisely the earliest processes, and observed only the stage in which the ectoderm is seen already invaginated. The examination of larvæ of all ages, still enclosed in the peribranchial cavity and cut into thin sections, is the only method that enables us to decide the question with accuracy.

It is important to determine the origin of the peribranchial cavity in Simple Ascidians, on account of the conclusions with regard to blastogenesis in the Botryllidæ which have been quite recently deduced therefrom by a Norwegian ascidiologist named Hjort*. We know that in Compound Ascidians the branchio-intestinal cavity of each bud is produced by the proliferation of the outer peribranchial wall of the parent ascidiozoid, *which is of endodermal origin* in the larva as well as in the bud, as was shown by me in a former paper†. Hjort, without making a study of the Botryllid larva, has applied to it, with regard to the origin of the

* 'Anatomischer Anzeiger,' Band x. no. 7.

† 'Annales des Sciences naturelles,' 1892.

peribranchial sacs, the results obtained by Metschnikoff and Kovalewsky in the case of Simple Ascidians, and has consequently arrived at the conclusion that *the branchio-intestinal cavity is of endodermal origin* in the larvæ of Compound Ascidians, *while it is a formation of the ectoderm* in their buds.

In this particular case, therefore, I am unable to share Hjort's opinion; the larvæ of *Amaroncium Nordmanni* and *Fragarium elegans* * had already led me to the same results as the Botryllidæ and Simple Ascidians, as to the endodermal origin of the peribranchial cavity; and herein I am in accord with Della Valle †, who studied *Ascidia mentula*.

But if the epicardium is a formation of general occurrence in Tunicates, it does not possess the property of blastogenesis in all of them. This property is non-existent in the Simple Ascidians, in which the epicardium surrounds the alimentary canal and simply plays the part of peritoneum. In the Botryllidæ the epicardium exhibits the same arrangement as in the Simple Ascidians, but *the peribranchial wall*, which, after all, is nothing but the foremost portion of the epicardiac sacs, possesses the property of budding. Finally, in the Polyclinidæ (*Amaroncium*, *Circinalium*, &c.), in *Clavellina* and *Perophora* we know that the epicardium is extended to the tip of the stolon or of the peduncle when it exists, and this it is that, by dividing or proliferating in different ways according to the particular group, gives rise to the enteric cavity of the new buds.

IV.—I have traced, in series of thin sections, the development of the nervous system of the larva as well as of the fixed Ascidian, and have succeeded in elucidating various points with reference to the sensory vesicle, as to which Kuppfer and Kovalewsky were unable to agree.

The sensory vesicle never opens on the surface of the ectoderm, as it was stated to do by Kovalewsky; but at a very early period it is brought into connexion with the anterior portion of the future branchial sac by means of a very short tube, which still exists, at the moment of fixation, in order to give rise to the *vibratile organ*. This communication between the nervous vesicle and the branchial sac is of variable duration in the different species; it no longer exists in *Ascidia villosa* at the time of hatching, any more than in the larvæ of *Amaroncium* and *Fragarium*; while in *Cynthia morus* the communication is still very wide on the second day after hatching.

The nervous system of the adult is produced by that of the larva before it commences to degenerate, and by means of a process which recalls that which I have already described in the case of *Fragarium elegans* and *Amaroncium Nordmanni* ‡.—*Comptes Rendus*, t. cxxi. no. 5 (July 29, 1895), pp. 270–273.

* 'Comptes Rendus,' February 25, 1895.
† 'Archives italiennes de Biologie,' t. ii. 1882.
‡ 'Comptes Rendus,' February 25, 1895.